

WHAT IS CLAIMED IS:

- 1                    1.        A method of filling a gap formed between adjacent raised  
2 surfaces of a substrate, the method comprising:  
3                    depositing a layer of spin-on glass material over the substrate and into  
4 the gap;  
5                    exposing the layer of spin-on glass material to a solvent;  
6                    curing the layer of spin-on glass material; and  
7                    depositing a layer of silica glass over the cured spin-on glass layer using  
8 a chemical vapor deposition technique.
- 1                    2.        The method of claim 1 wherein the chemical vapor deposition  
2 technique is a plasma CVD process.
- 1                    3.        The method of claim 2 wherein the plasma CVD process is a  
2 high density plasma CVD process that includes simultaneous sputter and deposition  
3 components.
- 1                    4.        The method of claim 1 wherein the spin-on glass material is  
2 cured using radiation in the form of an electron beam.
- 1                    5.        The method of claim 1 wherein the spin-on glass material is  
2 cured using process comprising:  
3                    exposing the spin-on glass material to an electron beam during a first  
4 period; and  
5                    thereafter, increasing a temperature of the substrate and exposing the  
6 spin-on glass material to an electron beam during a second period.
- 1                    6.        The method of claim 5 wherein the solvent comprises isopropyl  
2 alcohol.
- 1                    7.        The method of claim 5 wherein the temperature of the substrate  
2 is increased by at least 50 degrees Celsius between the first period and the second  
3 period.

- 1                    8.        The method of claim 5 wherein the temperature of the substrate  
2 is increased by at least 150 degrees Celsius between the first period and the second  
3 period.
- 1                    9.        The method of claim 1 wherein the spin-on glass material is  
2 deposited from a liquid precursor solution comprising hydrogen silsesquioxane.
- 1                    10.       The method of claim 1 wherein the spin-on glass material  
2 partially fills the gap.
- 1                    11.       The method of claim 10 wherein the spin-on glass material has a  
2 dielectric constant of less than 2.9.
- 1                    12.       The method of claim 11 wherein the layer of silica glass  
2 deposited with a chemical vapor deposition technique completely fills the gap.
- 1                    13.       The method of claim 1 wherein the solvent is applied to the  
2 substrate using a spray or spin-on technique.
- 1                    14.       The method of claim 1 wherein the solvent is allowed to dry  
2 prior to curing the layer of spin-on glass material.
- 1                    15.       The method of claim 1 wherein the substrate is not heated while  
2 the solvent is applied.
- 1                    16.       The method of claim 1 further comprising depositing a second  
2 layer of spin-on glass material over the substrate and into the gap prior to depositing the  
3 layer of silica glass using a chemical vapor deposition technique.
- 1                    17.       A method of filling a plurality of gaps formed between raised  
2 surfaces of a semiconductor substrate, the plurality of gaps including a plurality of  
3 closely-spaced gaps formed in an active area of the substrate and at least gap formed in  
4 an open area of an integrated circuit being formed on the substrate, where a width of  
5 the gaps in the open area is significantly wider than a width of at least some of the  
6 plurality of closely-spaced gaps in an active area of the integrated circuit, the method  
7 comprising:

8                    depositing a layer of spin-on glass material over the substrate such that it  
9    at least partially fills the plurality of gaps;  
10                  exposing the layer of spin-on glass material to a solvent;  
11                  curing the layer of spin-on glass material; and  
12                  depositing a layer of silica glass over the cured spin-on glass layer using  
13    a high density chemical vapor deposition technique that includes simultaneous  
14    deposition and sputter components.

1                    18.    The method of claim 17 wherein the spin-on glass material is  
2    cured using process comprising:

3                    exposing the spin-on glass material to an electron beam during a first  
4    period; and

5                    thereafter, increasing a temperature of the substrate and exposing the  
6    spin-on glass material to an electron beam during a second period;

7                    wherein the temperature of the substrate is increased by at least 50  
8    degrees Celsius between the first period and the second period.

1                    19.    The method of claim 17 wherein the gaps are formed in a silicon  
2    substrate having one or more dielectric layers formed thereon such that the plurality of  
3    gaps form islands there between, the islands comprising an upper strata of dielectric  
4    material and a lower strata of silicon and wherein the solvent treatment step removes  
5    spin-on glass material from sidewalls of gaps in the open area such that any remaining  
6    spin-on glass material in the gaps in the open area is below the upper strata of dielectric  
7    material and wherein the method further comprises planarizing the shallow trench  
8    isolation structure down to the lower silicon strata.

1                    20.    The method of claim 17 wherein the spin-on glass material is  
2    deposited from a liquid precursor solution comprising hydrogen silsesquioxane.

1                    21.    The method of claim 17 further comprising exposing the cured  
2    spin-on glass layer to an oxygen plasma prior to depositing the silica glass layer.